DERIVATION TREE

Derivation tree is a graphical representation for the derivation of the given production rules for a given CFG. It is the simple way to show how the derivation can be done to obtain some string from a given set of production rules. The derivation tree is also called a parse tree.

Parse tree follows the precedence of operators. The deepest sub-tree traversed first. So, the operator in the parent node has less precedence over the operator in the sub-tree.

A parse tree contains the following properties:

1. The root node is always a node indicating start symbols.
2. The derivation is read from left to right.
3. The leaf node is always terminal nodes.
4. The interior nodes are always the non-terminal nodes.

Example :

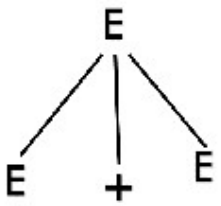
Production rules:

1. E = E + E
2. E = E * E
3. E = a | b | c

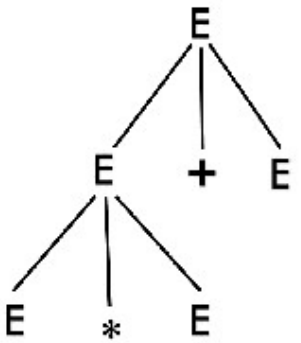
Input

1. a * b + c

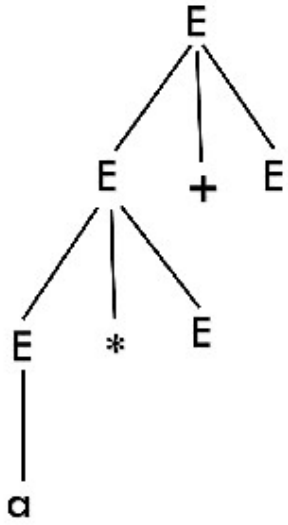
Step 1:



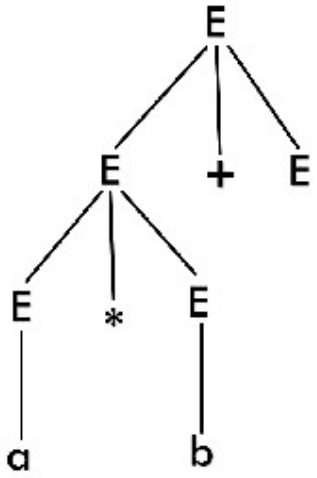
Step 2:



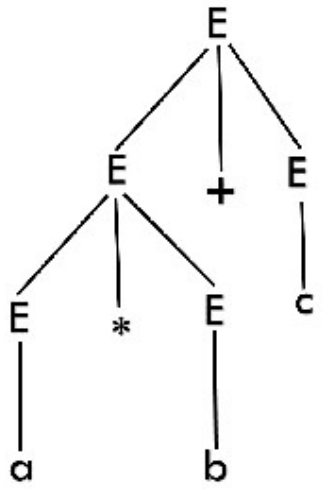
Step 2:



Step 4:



Step 5:



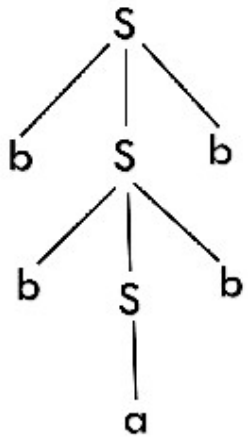
Example :

Draw a derivation tree for the string "bab" from the CFG given by

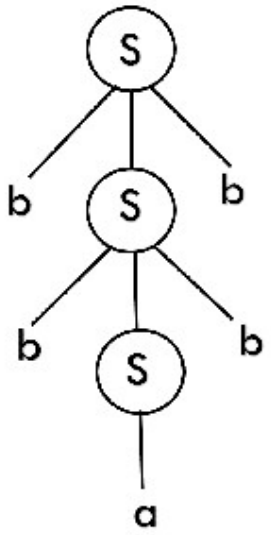
1. S → bSb | a | b

Solution:

Now, the derivation tree for the string "bbabb" is as follows:



The above tree is a derivation tree drawn for deriving a string bbabb. By simply reading the leaf nodes, we can obtain the desired string. The same tree can also be denoted by,



Example :

Construct a derivation tree for the string aabbabba for the CFG given by,

1. S → aB | bA
2. A → a | aS | bAA
3. B → b | bS | aBB

Solution:

To draw a tree, we will first try to obtain derivation for the string aabbabba

S

aB

a aBB

aa bS B

aab bA B

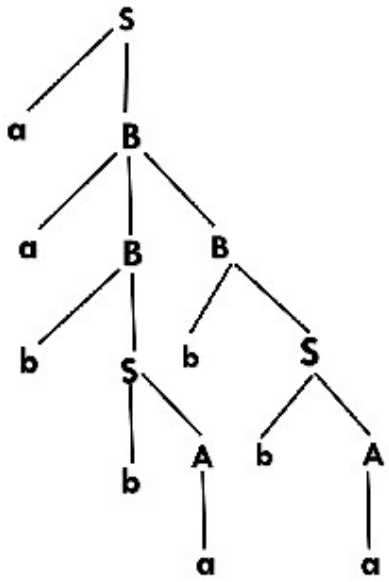
aabb a B

aabba bS

aabbab bA

aabbabb a

Now, the derivation tree is as follows:



Example 4:

Show the derivation tree for string "aabbbb" with the following grammar.

1. S → AB | ε
2. A → aB
3. B → Sb

Solution:

To draw a tree we will first try to obtain derivation for the string aabbbb

S

AB

aB B

a Sb B

a AB bB

a aB BbB

aa Sb BbB

aa ε bBbB

aab Sb bB

aab ε bbB

aabbb Sb

aabbb ε b

aabbbb

Now, the derivation tree for the string "aabbbb" is as follows: